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43. Мог ли Советский Союз принимать телерепортаж с "Аполлона-11", записанный в американском формате?

23-29 minutes

It is reliably known that the onboard and ground radio-technical means of control of spaceships of the Soviet lunar program could not be used to receive information from the Apollo spacecraft, since they operated in a different frequency range with signals having a different structure.

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There is a legend that in July 1969, American astronauts landed on the moon (it was the Apollo 11 mission) and from there they sent a television report to Earth, the so-called "live broadcast from the moon". This legend was supported by some of our famous cosmonauts, for example, Georgy Grechko, claiming that this television report was received here, in the Soviet Union, and it was from the Moon.

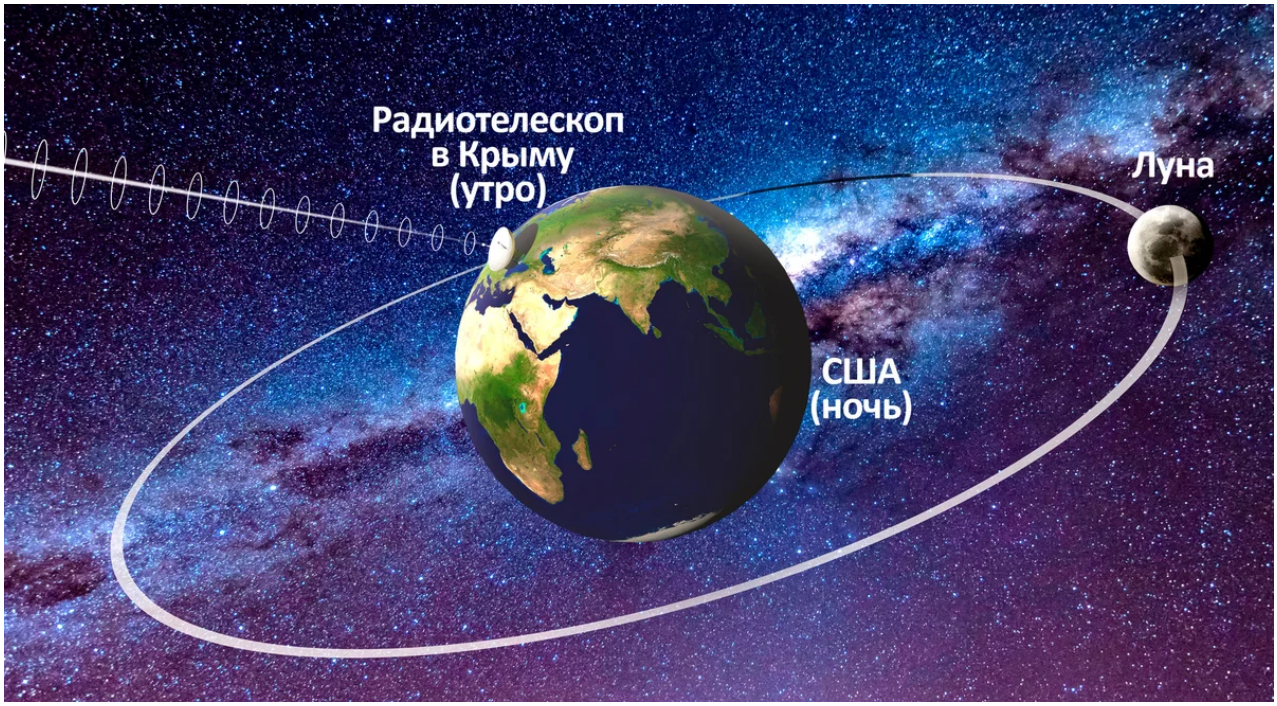
In 2013, in In an interview with Nikola Krastev, Georgy Grechko said:

- ... You probably know that the whole world watched as the Americans were the first - Neil Armstrong and Baz Aldrin - to walk on the moon. And in China, it means that a patriotic film was shown, and here, in my opinion, as always in such cases - "Swan Lake". **But at the technical center in Shabolovka, in such a closed room, our television crews received a signal from the moon.** And so, we, the cosmonauts, watched with envy on the one hand that the Americans walk there, not us, and on the other hand, with joy, it is natural that humanity, now, has made another powerful step into space.

IN interview with BBC (BBC) G. Grechko added:

- And the fact that the Americans were on the moon, we know for sure. When we received signals from the Moon, we received them from the Moon, not from Hollywood.

IN In the previous article, we wrote that at the hour when the whole world was watching the descent of the dwarf astronaut along the ladder of the lunar module, the Moon was not visible from the territory of the Soviet Union, and the Soviet Union, in principle, could not receive any signal from the Moon at the indicated hour. Therefore, it remained a mystery to us how **"our TV crews received a signal from the moon"**if it was hidden behind the horizon? When it's day in Moscow, it's night in the USA. When US residents see the sun, we do not see it, we have night at this time. And in the same way, when the Moon is visible from the territory of the United States, it is below the horizon for us and is not visible. A radio telescope was built in Crimea to communicate with the Moon (and control the Soviet lunar rovers). But at the hour designated by NASA as the astronauts' exit to the moon, the radio telescope in Crimea could not receive any signals from the moon.



During the "live broadcast" the Moon was over America and the Pacific Ocean and was not visible from the territory of the Soviet Union. A radio telescope in the Crimea is aimed at the sky.

The Far East of the USSR, in principle, could see the Moon, but there were no radio telescopes capable of receiving a signal from the Moon.

We also wrote that the person who in the video went down the ladder of the lunar module was about 40 cm shorter than Armstrong, i.e. was not the astronaut whose names were on hearing, but just an unnamed dwarf. We wrote an article about this. "Who instead of Armstrong went down the stairs?"

As for the reception of signals from the Moon, they began to write to us that the Soviet Union, in addition to the radio telescope in the Crimea, which was created for communication with our lunar rovers on the Moon and spacecraft in lunar orbit, also had research ships and ships of long-range space communications in the ocean. And in the comments 3 times they cited the ship "Cosmonaut Yuri Gagarin" as an example.

Space communications ship Cosmonaut Yuri Gagarin.

But this ship, like the long-range space communications ship Akademik Sergei Korolev, which could receive signals from the Moon, were built in 1971 and therefore could not receive signals in 1969.

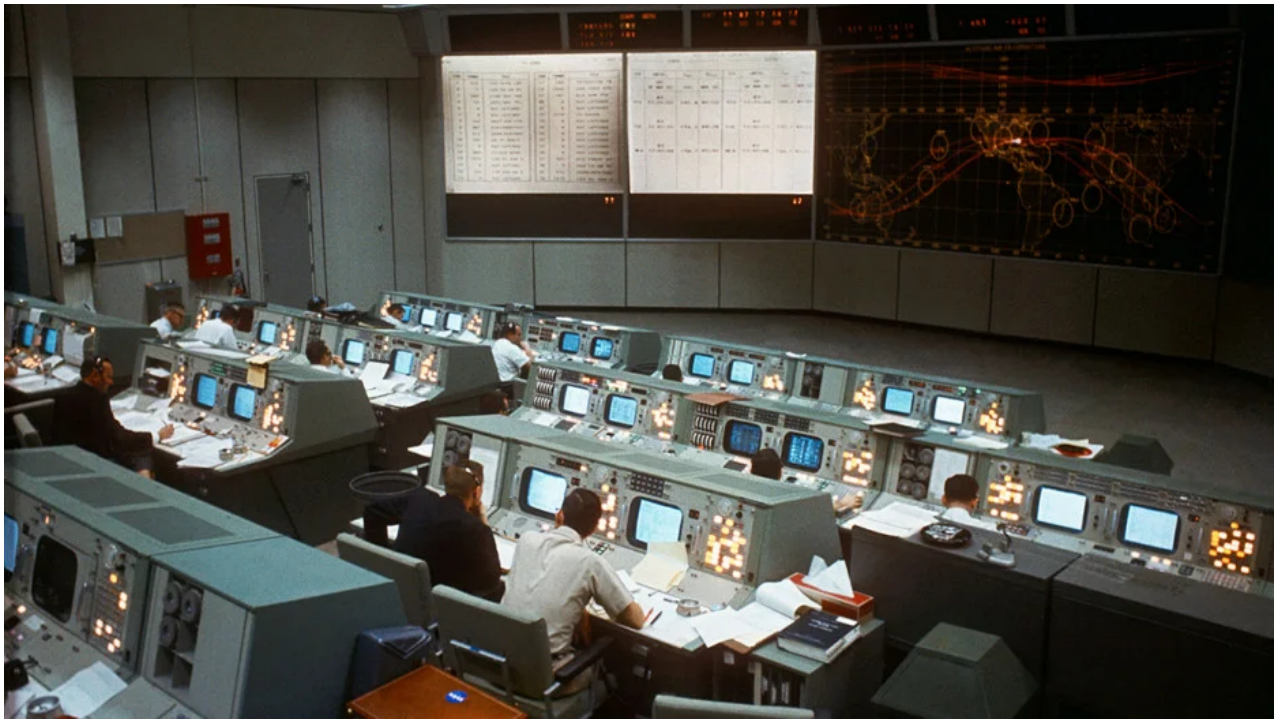
In addition, the defenders of the American lunar scam began to press on the following circumstance: *"Yes, the Moon during the" live broadcast "was not visible from the Crimean Observatory. But 4 hours after the end of the" broadcast "the Moon appeared over the horizon in Crimea, and the Soviet Union could receive a signal from the Moon And since Apollo 11 still remained on the surface of the Moon (according to NASA legend, it stayed there for 21 hours), the Soviet Union could theoretically receive telemetry, voice messages, video images and other signals from Apollo 11 "."*

Since such assumptions are not devoid of logic, we theoretically consider the option of whether the Soviet Union could not only receive the American signal from the moon, recorded in a special format, but also decode it and translate it into a television picture.

In this regard, half of the article will be devoted to recording formats.

According to NASA, the television signal from the moon did not go separately, but along with telemetry. When they talk about space telemetry, they mean that there are sensors on the spacecraft, and in real time they send information to Earth about the readings of hundreds of instruments.

During the launch of the spacecraft, we see that the mission control center is filled with specialists. Being at the monitors, they follow the readings of control and measuring instruments and sensors, of which there are several hundred on the spacecraft, and also monitor the state of the astronauts (or cosmonauts) themselves - pulse, respiration, body temperature, etc.

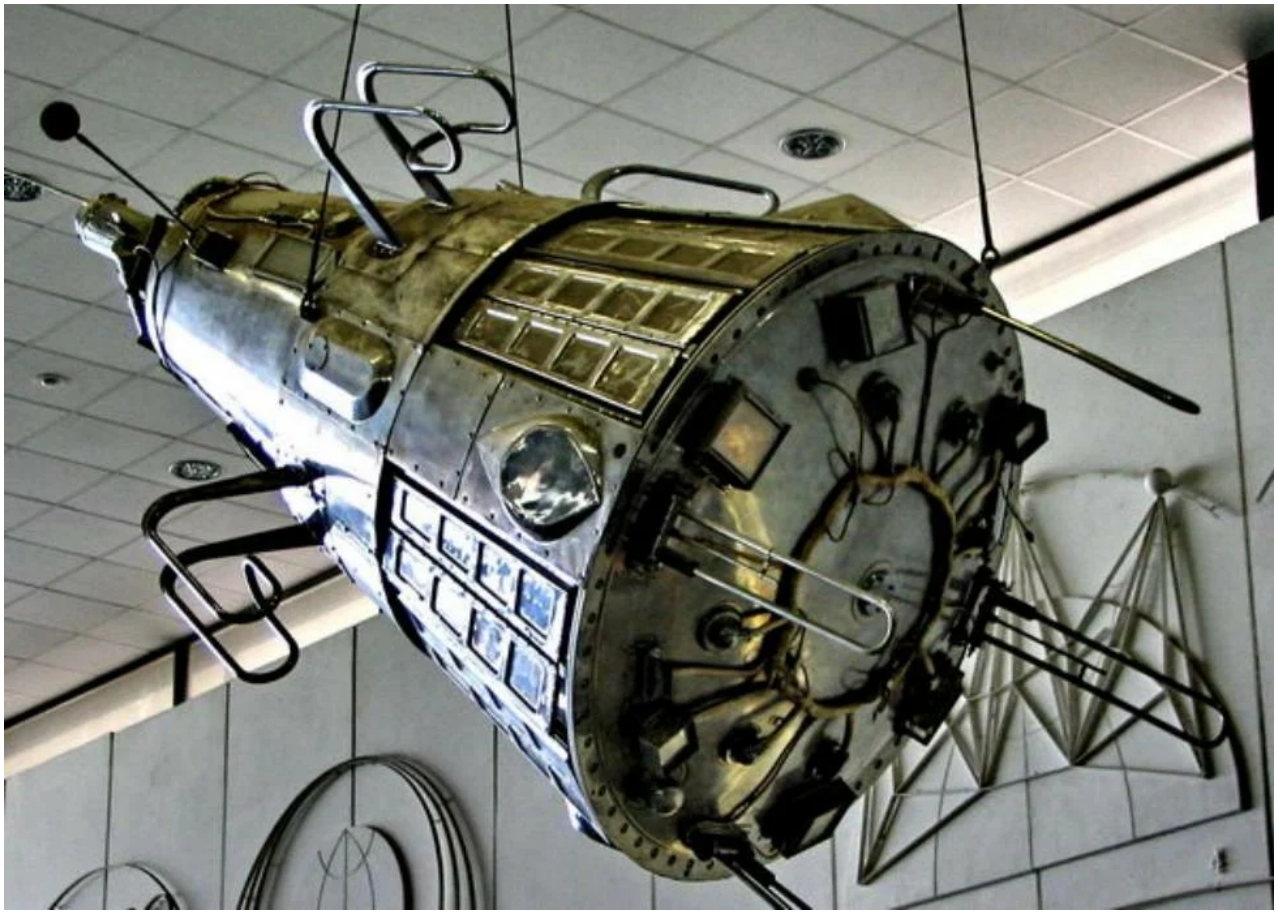


Houston Mission Control Center.

In the flight control center.

At the beginning of the space era in the USSR, various developments were underway for the transmission of telemetry. telemetry systems , differing in the number of channels, measurement accuracy, radio communication range. Among them, the "Tral" system stood out, which had 48 measuring channels, with a total information content of 6000 measurements per second.

Each launch vehicle carries a telemetry system and antennas for transmitting it to the ground. Tral telemetry is easily recognizable by the side antennas, which look like large paper clips.



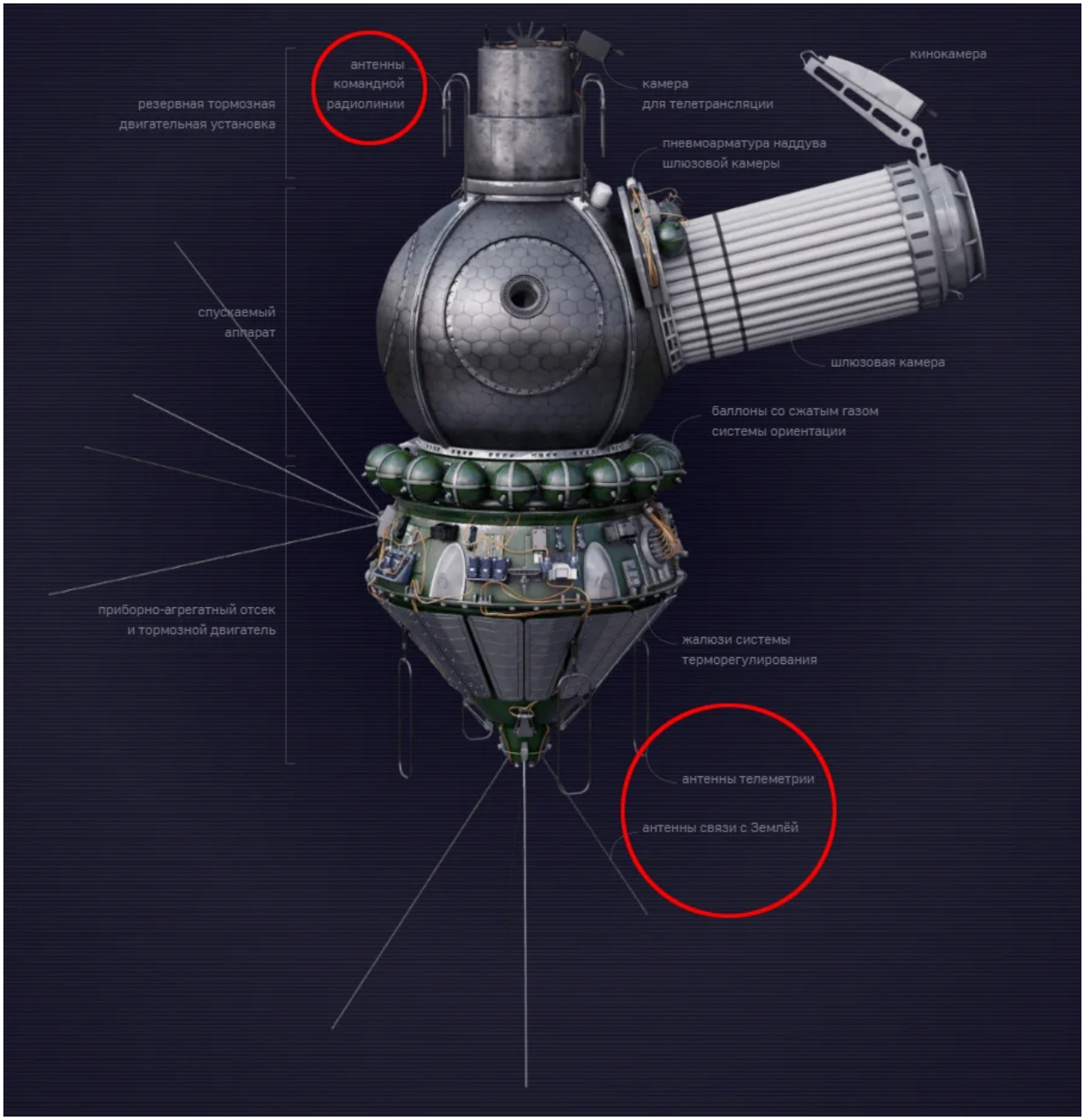
Sputnik-3 (launched in 1958) with side antennas of the Tral telemetry system.

On the ground, there are receiving complexes that receive and process telemetry data.

Soyuz starts. Telemetry is received by the Daisy antenna installation.

In manned astronautics, in addition to receiving telemetry, it was necessary to transmit commands to the spacecraft and receive television signals - a video picture. This required independent transmitting antennas.

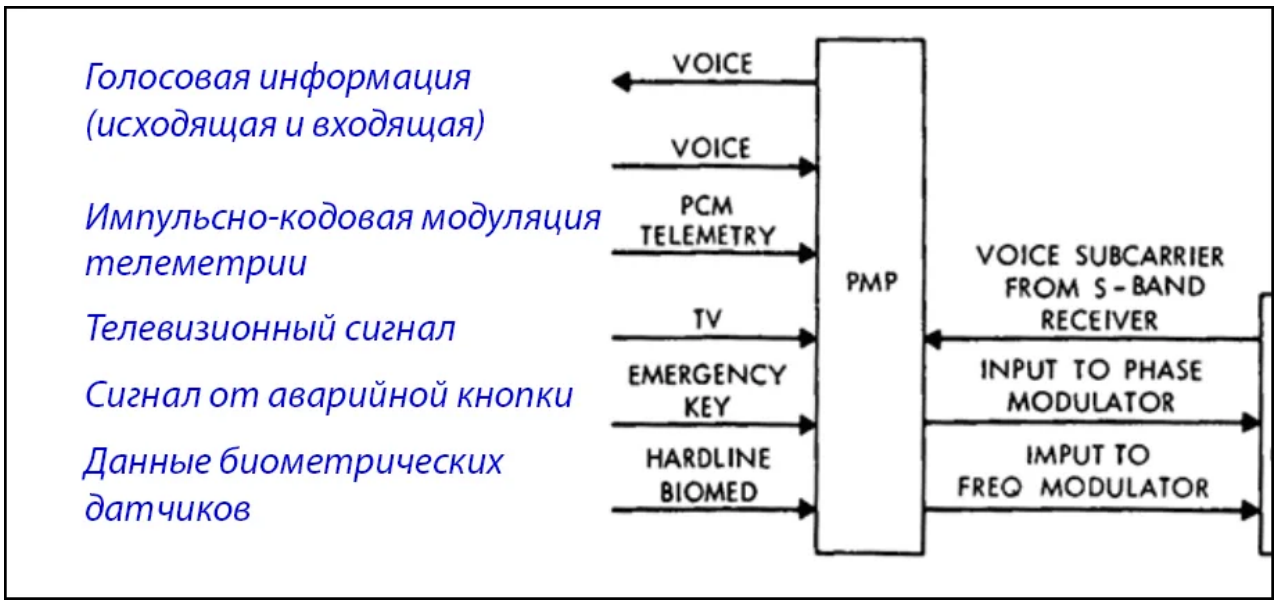
So, in the picture of the Voskhod-2 spacecraft, from which A. Leonov made a spacewalk in 1965, you can see the already familiar Tral telemetry antennas in the form of large paper clips, as well as other antennas for communication with The ground and for the transmission of commands.



Voskhod-2 spacecraft with antennas for various purposes.

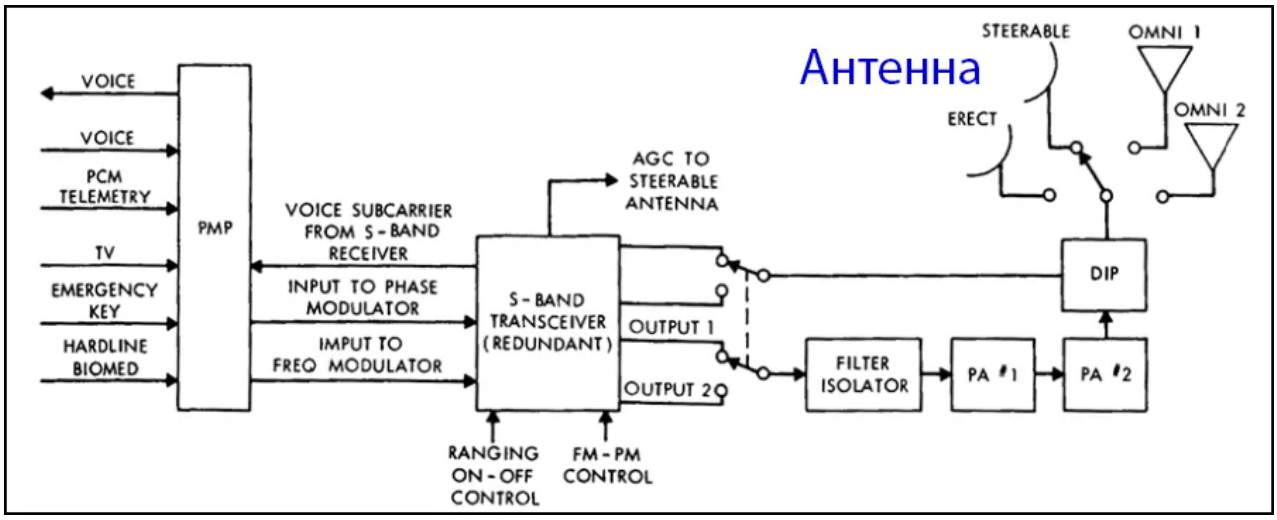
US intelligence used the "Radio Research Laboratory" of the Japanese Ministry of Posts and Telecommunications to monitor Soviet manned flights, intercepting signals on a frequency of 19.995 MHz.

The Apollo project had a different communication concept, in which all voice, telemetry, television and rangefinder information for near-Earth and lunar distances, as well as control and tracking, were transmitted over a single frequency system. This system was called a single S-band ("S" for " ***S*** hort-band"). The S-band extends from 2 to 4 GHz. For transmission from the Moon, a wavelength of 13 cm was chosen, a frequency of 2.28 GHz (2.2875 for the command module and 2.2825 for the lunar module).



Components of a single signal.

All information, both outgoing and incoming, was transmitted over one antenna.



Block diagram of the "single S-band" of the Apollo lunar module.

NASA brochures say that the signal from the TV camera went to the antenna and from there, along with the stream of other information, was sent directly to Earth. In the next photo, where a mannequin depicting an astronaut is standing near the dummy lunar module, this circular transmitting antenna can be seen. It is located at the very top of the layout and is directed upward, supposedly to the Earth.

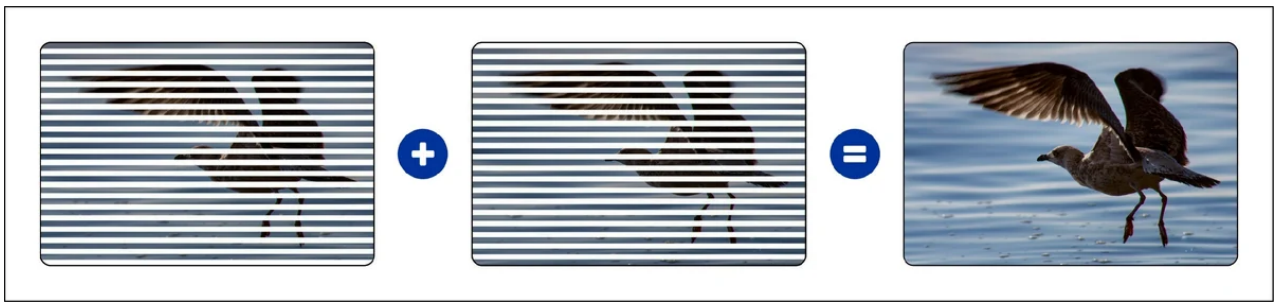
The S-band signal transmission antenna is located on top of the lunar module.

Together with the television signal, voice information, telemetry and commands are transmitted.

So, having received this single signal on Earth, something like "rush-rush-rush, beep-beep", we must extract telemetry, voice, commands, medical parameters from it, and find where the TV signal is encrypted. This TV signal is not like the regular NTSC TV signal used in the United States, so this TV signal cannot be simply fed to a TV antenna and watched.

Let's see how the "lunar" television signal differed from the usual broadcast television signal.

It is known that widely used in the world two options NTSC, letter indices designated **M** and **N** . Historically, the first was, and is now the most common variant, NTSC **M** (in the USA). In the NTSC format, which was adopted in the USA in 1953 for color television, frames change 60 times per second, since the AC frequency in the USA is 60 Hz. In fact, this is not quite a full-fledged 60 frames, these are 60 fields, consisting of either even or odd lines. Two fields, one with even lines, the other with odd lines), when superimposed on each other, give one full frame. There are 525 lines in the frame in total. Hence, accordingly, a half-frame will consist of either 262 even or 263 odd lines.



Two fields consisting of 263 odd and 262 even lines form one frame of 525 lines (lines).

Therefore, you can hear that the American television system NTSC transmits 30 "full" frames per second. In fact, this is, of course, 60 frames, more precisely, half frames. Moreover, a half-frame is a full-fledged picture that fills the entire screen from top to bottom, only with sparse lines. The beam sweeps across the entire screen from top to bottom 60 times within 1 second.

As you might guess, it was impossible to transmit television images in the format of the broadcast TV standard NTSC from space via radio communication at 60 pictures per second in those years. Moreover, in addition to the television picture, voice and telemetry were simultaneously transmitted over the same channel.

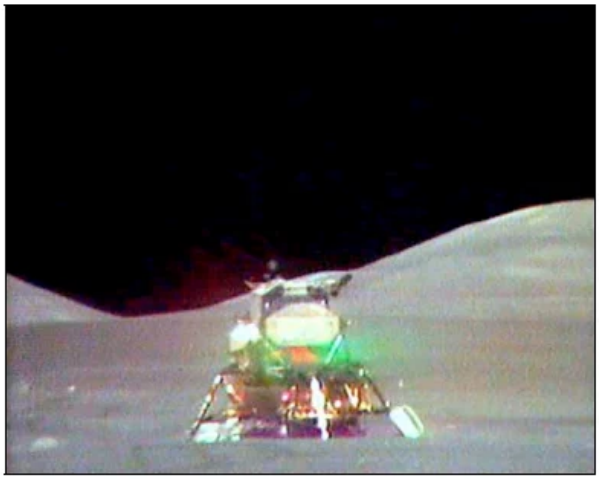
In the Soviet Union, for the transmission of television images from the Moon and for remote control of the lunar rovers, the chief designer of radio systems M.S. Ryazansky proposed to applya small-frame television system that transmitted one frame in 4 seconds. The frame was square and consisted of 400 lines. At the same time, the "picture" on the TV screen resembled the changing frames of a filmstrip. By commands from the Earth, it was possible to set different modes of transmission speed: 3.2; 5.7; 10.9 and 21.1 sec per frame.

Lunokhod remote control.

Lunokhod control. The picture shows the driver V. Dovgan.

The television image is transmitted to Earth on carrier frequency 750 *kHz* . In the modulator, this signal is mixed with the reference frequency of the onboard generator, which is necessary for synchronizing ground devices. The terrestrial receiving complex for low-frame television consists of equipment for demodulation, synchronization, conversion and image registration.

If the television system on "Lunokhod-1" worked for 10 months, then the "lunar television" of "Apollo-11" - only ... 2.5 hours. And, despite the fact that in all expeditions the cameras remained on the Moon and in the last expeditions the cameras on the rovers could be controlled from the Earth, nevertheless, after the departure of Apollo, not a single TV camera sent to Earth a single report in a day or in a week ... The only thing that we managed to find inNASA reports - a line that after leaving the moon, the Apollo 17 camera allegedly filmed for another 27 hours.



Apollo 17 LM ascent stage engine ignition!

Apollo 17 LM descent stage remains on the Moon

The performance of the Ground Controlled Television Assembly (GCTA) and the Lunar Communications Relay Unit (LCRU) was nearly flawless during the Apollo 17 stay in the Taurus-Littrow region on the Moon. The Rover color TV camera continued to operate for at least 27 hours after the Challenger liftoff at GET 188:01:36 when it was used to observe the detonation of Explosive Package Nr. 7. Some time after this the LCRU suffered an over-temperature failure preventing further use of the camera.

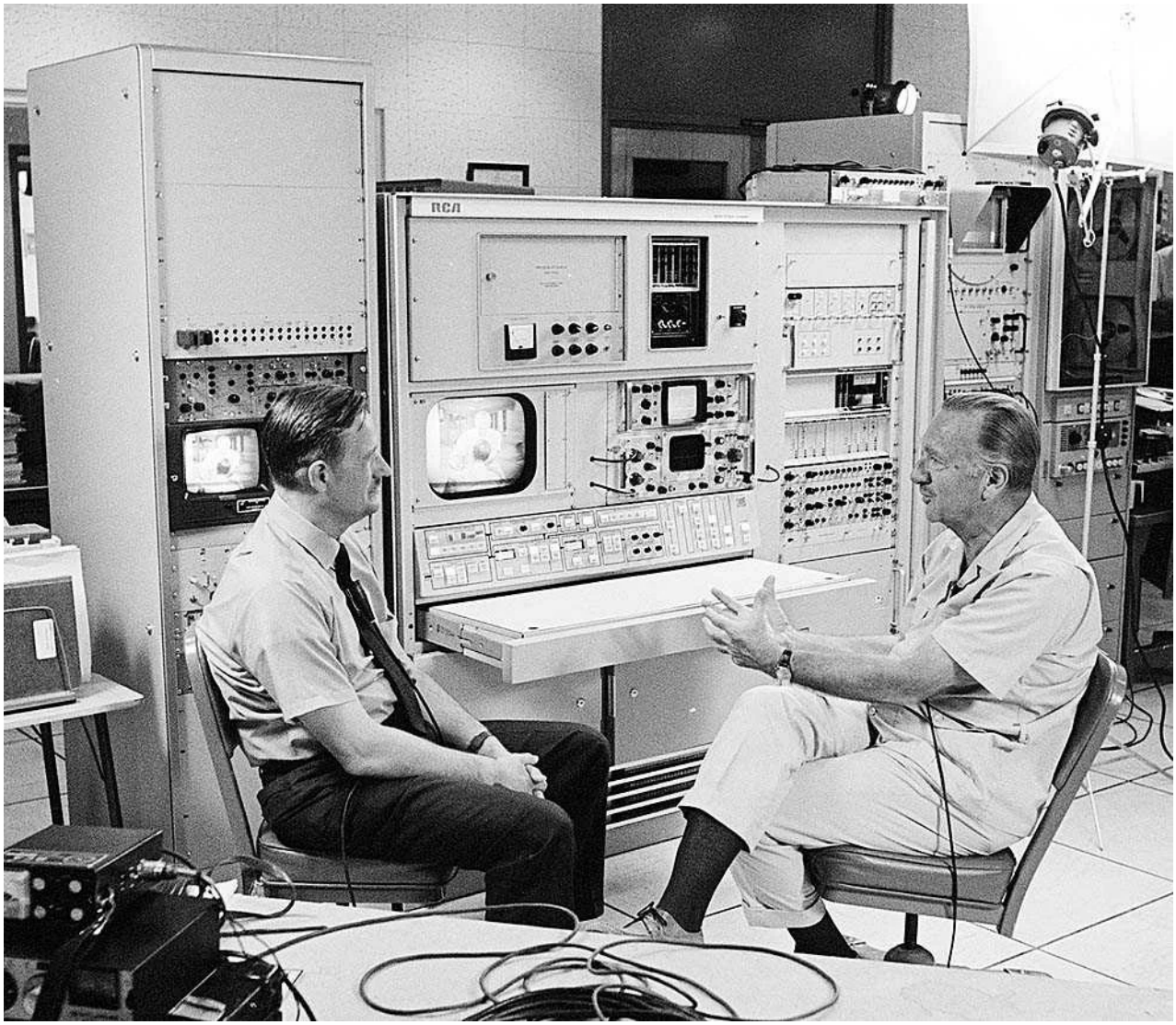
> "The color camera installed on the rover continued to operate (shoot) for at least 27 hours after the Challenger took off." (Note: the Apollo 17 command / service module was called America, the lunar module Challenger.)

The longest video recordings of "Apollo 17" , which I managed to find on Yu-Tuba, after the departure of the model of the spacecraft, the operator crawls the camera back and forth for about an hour.

The Apollo 11 lunar footage, according to NASA, was captured by the Westinghouse black-and-white television camera.

Westinghouse TV camera.

The camera was shooting at a speed of 10 frames per second, the frame consisted of 320 progressive scan lines. The image was irregular. Neither by the number of frames per second, nor by the number of lines. To broadcast a video picture, it was necessary to turn 320 lines into 525, and multiply 10 frames per second to 60. Such operations were carried out using a scan converter manufactured for this purpose by the RCA Astro Electronics division. RCA - Radio Corporation of America.



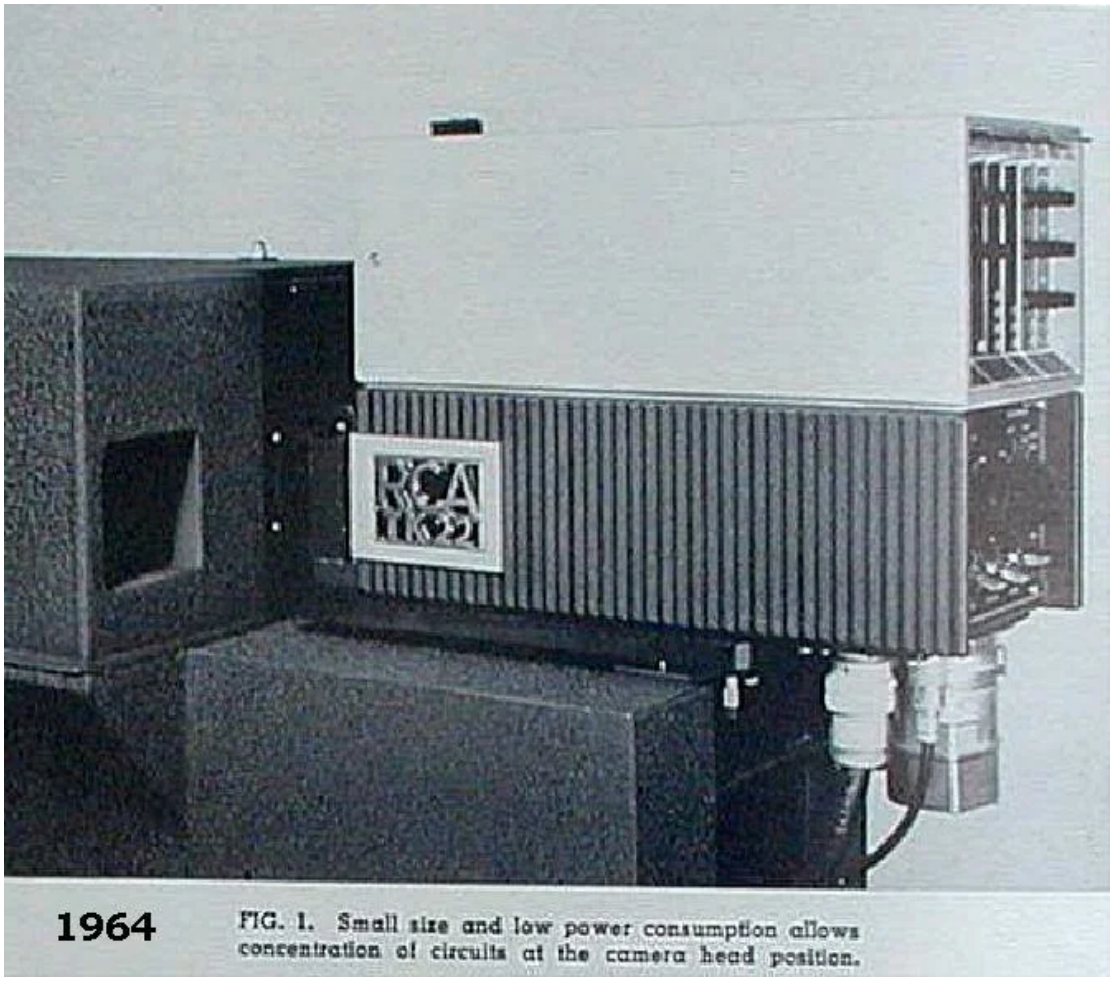
Scan converter.

From the Westinghouse TV camera (which was supposedly on the moon), the image was fed (naturally, after receiving and decoding the signal) to a monitor, a 10-inch cathode-ray tube (CRT).

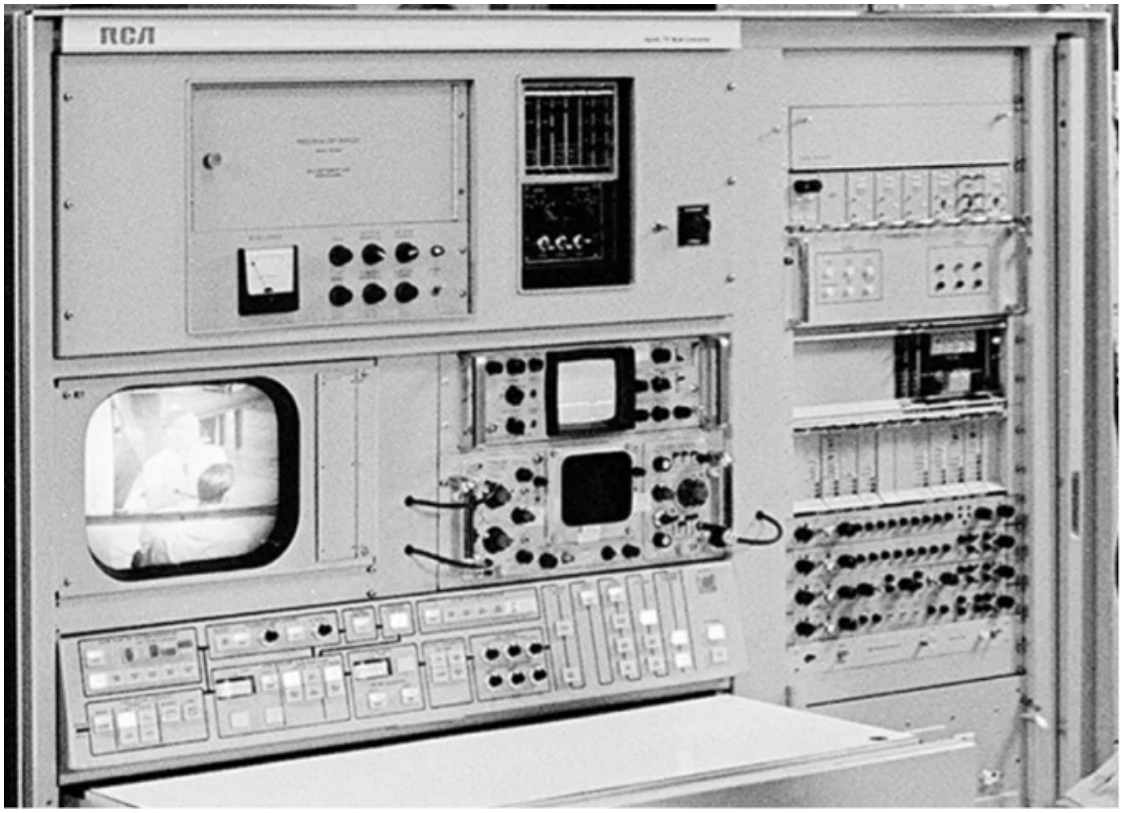
Unconverted image on a CRT screen.

The image from this monitor was captured by an RCA TK-22 TV camera, which worked in NTSC format.

TV camera RCA TK-22, front view.

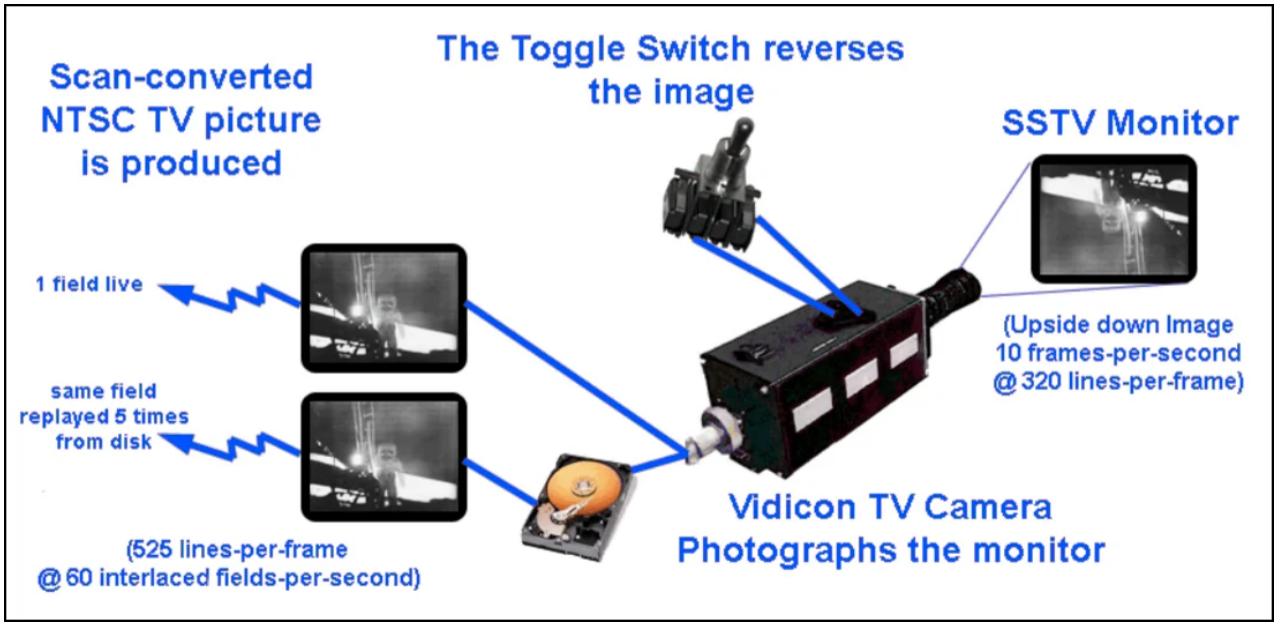


TV camera RCA TK-22, rear view.



On the left is a cathode ray tube (monitor). The dark rectangle on the right is the control of the RCA TK-22 TV camera.

The conversion process looked like this.



Converting a small-frame television signal to the NTSC broadcast standard.

In the figure in the upper right corner there is a monitor, a cathode-ray tube (CRT) of a small-frame television (10 frames per second). A screen about the size of an A4 sheet is captured by a TV camera (designation in the figure - TV Camera), operating in the NTSC format. The word "vidicon" next to the word "TV Camera" means roughly what we now call "matrix".

In reality, the vidicon looks like this:

Vidicon is a transmitting television tube.

The image formed by the camera lens is projected onto the end of the vidicon, where the photosensitive layer is placed. The higher the illumination of the target area, the lower the resistance of this area, as a result of which, when scanning with an electron beam of the sweep, the beam current turns out to be weak over unlit areas with high target resistance, and strong over illuminated areas with low target resistance.

The 10 frames per second that the Westinghouse camcorder gives on Apollo needs to be turned into 60 NTSC fields (half frames) or, in other words, 30 "full" NTSC frames. To do this, the frames are multiplied using a disc recorder, which was originally intended to slow down television replays of sports events. For example, on television, we see athletes crossing the finish line in slow motion. Since it is impossible to change the display frequency in television, motion slowdowns are produced by multiplying frames using a disk recorder.

This disk recorder (it is in the figure below, in the middle) has been modified to work as a recorder and duplicator of frames. With this recorder, 1 frame of the original was transformed into 6 fields (half frames) NTSC, or 3 full frames. The figure shows (lower left corner) that one frame is sent to the converter, and the required up to six fields, an additional 5 frames, are taken as a replay from the disk.

Here is the sequence of converting one frame of the original (from the Westinghouse camera) to 6 NTSC half-frames (to 3 "full" frames).

1. The first frame of the original from the Westinghouse TV camera with progressive scan is displayed on the monitor.

2. The TK-22 television camera runs its ray around odd lines (scans the image), writes this field (half-frame) to the disk recorder and sends it in real time to the video output of the converter. What is sent directly to the converter is referred to as "1 field live".

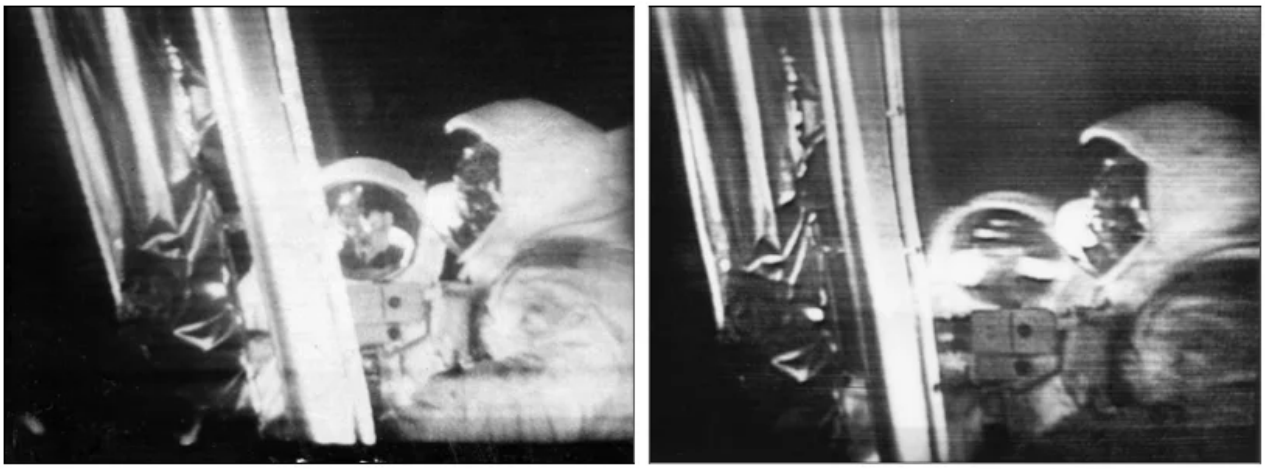
3. Further, for the NTSC format, you need to transfer even lines to the converter. This image is taken from a disk recorder. But since the feed of even and odd lines is spaced in time, the feed is delayed in time by 1/30 s (more precisely, by 31.8 microseconds - the value is taken from the NASA report) so that the even lines overlap the odd ones. This creates the first full interlaced NTSC 525 frame.

4. Then the same field recorded on the disc is reproduced, but without delay it is directed to the video output of the converter.

5. After that, the field recorded on the disc is delayed by about 1/30 s and fed to the video output. This is how the second NTSC frame is formed.

It takes 6 interlaced fields to turn each Westinghouse frame into three “full” NTSC frames. It is for these purposes that the disk recorder is used. Due to the fact that in NTSC, both for even fields and for odd ones, the same image is used, obtained by scanning only half of the lines from 525, the final image on the TV screen (for viewers) actually consists of 262 lines instead of 320 lines of the original. Therefore, the quality of the picture on the air is deteriorating, despite the apparent increase in the number of lines.

On American sites you can find a comparison of what the image looked like on the screen of a cathode-ray tube, obtained from a Westinghouse TV camera, and how it looked after passing through a scan converter.



Original 320 line, 10 frame per second Parkes Image, GET 109:52:35

Scan Converted 525 line, 30 frame per second Image, GET 109:52:30

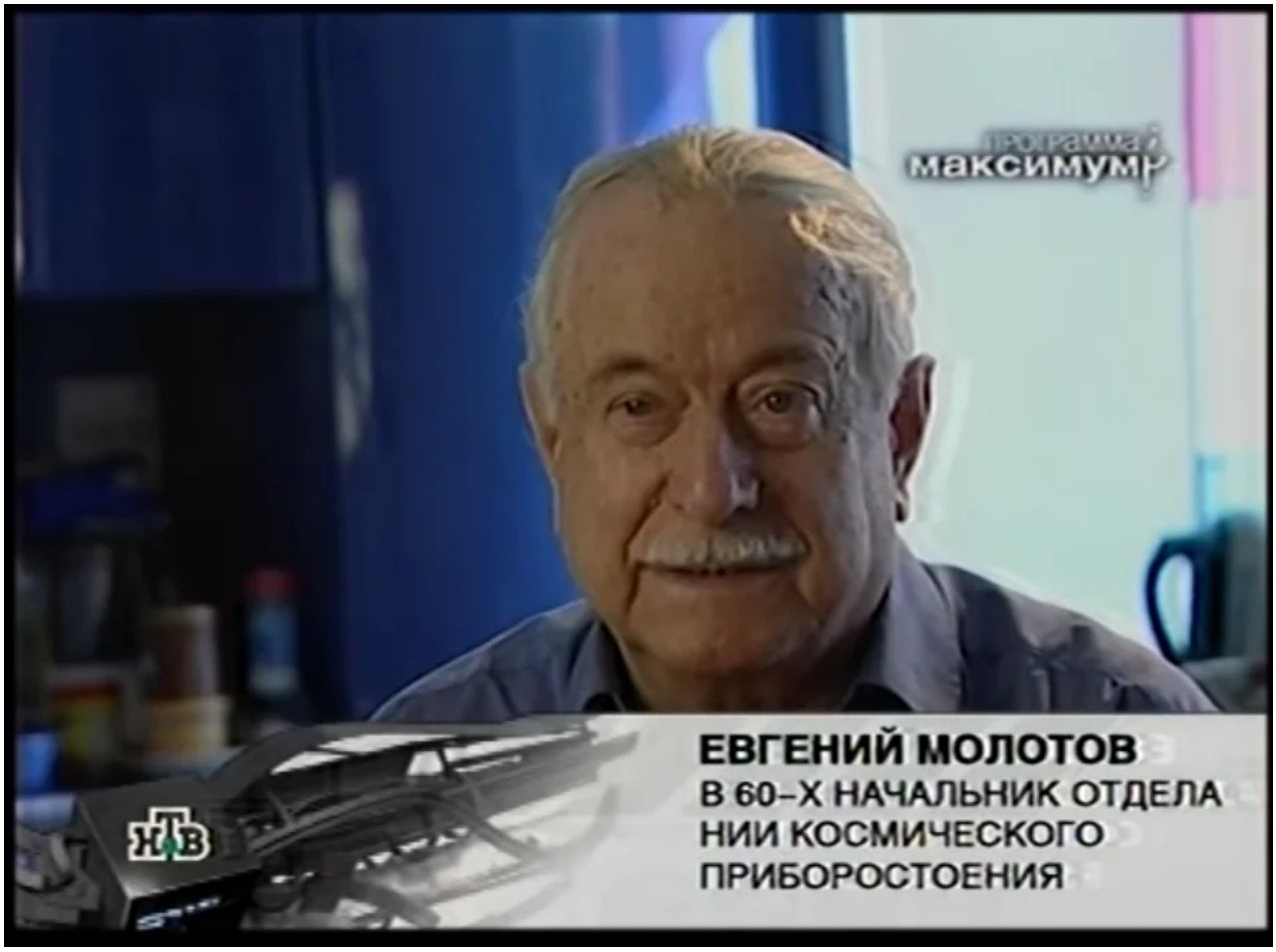
> On the left - the original image from the Westinghouse camera, re-captured by the camera on the Polaroid, on the right - the image passed through the scan-converter and ready for broadcast.

And now we can return to the question raised in the title of the article: could the Soviet Union receive a television report recorded in the American format?

In the comments, they write to us that theoretically we (the Soviet Union) could receive a signal from the Moon from the Americans, because Apollo 11 did not immediately fly off the Moon, but was there for 21 hours. During this time, 4 hours after the end of the so-called " live broadcast ", the Moon became visible from the territory of Crimea, where there was a powerful radio telescope, and the Americans could send some signals to Earth. Or a signal from the moon could be received by a distant space communications ship in the ocean.

I will not discuss the fact that our radio telescopes operated at different frequencies, in a completely different, L-band. Let this question about frequencies and subcarriers be discussed by radio engineers.

In any case, E. Molotov



in the journal "Cosmonautics News", No. 8 for 2005, writes the following:

- "MS Ryazansky at that time was responsible for the creation of onboard and ground radio-technical means of control of spaceships of the Soviet lunar program. Under his leadership, a Ground Control Complex was created to control Soviet manned and unmanned spacecraft for exploration of the Moon, which included **two control centers. flight, six ground and three naval command posts** , equipped with appropriate tracking stations and located on the territory of the Soviet Union and in certain points of the World Ocean. However, **these means could not be used to receive information from the Apollo spacecraft, since they operated in a different frequency range with signals having a different structure.** "

СТРАНИЦЫ ИСТОРИИ

Эксклюзивный материал

Мы «видели», как американцы садились на Луну...

Предлагаемая читателям статья участника событий 30-летней давности Е.П.Молотова проливает свет на неизвестные страницы «лунной гонки» и окончательно закрывает нелепый вопрос «Были ли американцы на Луне?»

Е.Молотов
специально для «Новостей космонавтики»

Прошло более 30 лет с того времени, как была развернута самая дорогостоящая гонка между Советским Союзом и Соединенными Штатами

Советского Союза и в определенных точках Мирового океана. Однако эти средства не могли быть использованы для приема информации с кораблей «Аполлон», так как они работали в другом частотном диапазоне с сигналами, имеющими другую структу-

РНИИ КП в кооперации с несколькими промышленными предприятиями, был готов к приему сигналов с космических кораблей программы «Аполлон» в ноябре 1968 г.

Для того чтобы отслеживать корабли при их полете по орбитам вокруг Луны и

М.С.Рязанский в то время отвечал за создание бортовых и наземных радиотехнических средств управления космическими кораблями советской лунной программы. Под его руководством для управления советскими пилотируемыми и автоматическими космическими кораблями для исследования Луны был создан Наземный комплекс управления, включавший в себя два центра управления полетом, шесть наземных и три корабельных пункта управления, оснащенных соответствующими станциями слежения и расположенных на территории Советского Союза и в определенных точках Мирового океана. Однако эти средства не могли быть использованы для приема информации с кораблей «Аполлон», так как они работали в другом частотном диапазоне с сигналами, имеющими другую структуру.

52

НОВОСТИ КОСМОНАВТИКИ

A scan of a page of E. Molotov's article from the Cosmonautics News magazine.

I am interested in another question. Well, let's say we received a coded signal from the Americans. Let us suppose, purely theoretically, that they could easily decompose their single signal into its components - they

isolated the voice, telemetry, commands and the television signal. And now we have a television signal on a magnetic tape in the form of "rush-rush-rush".

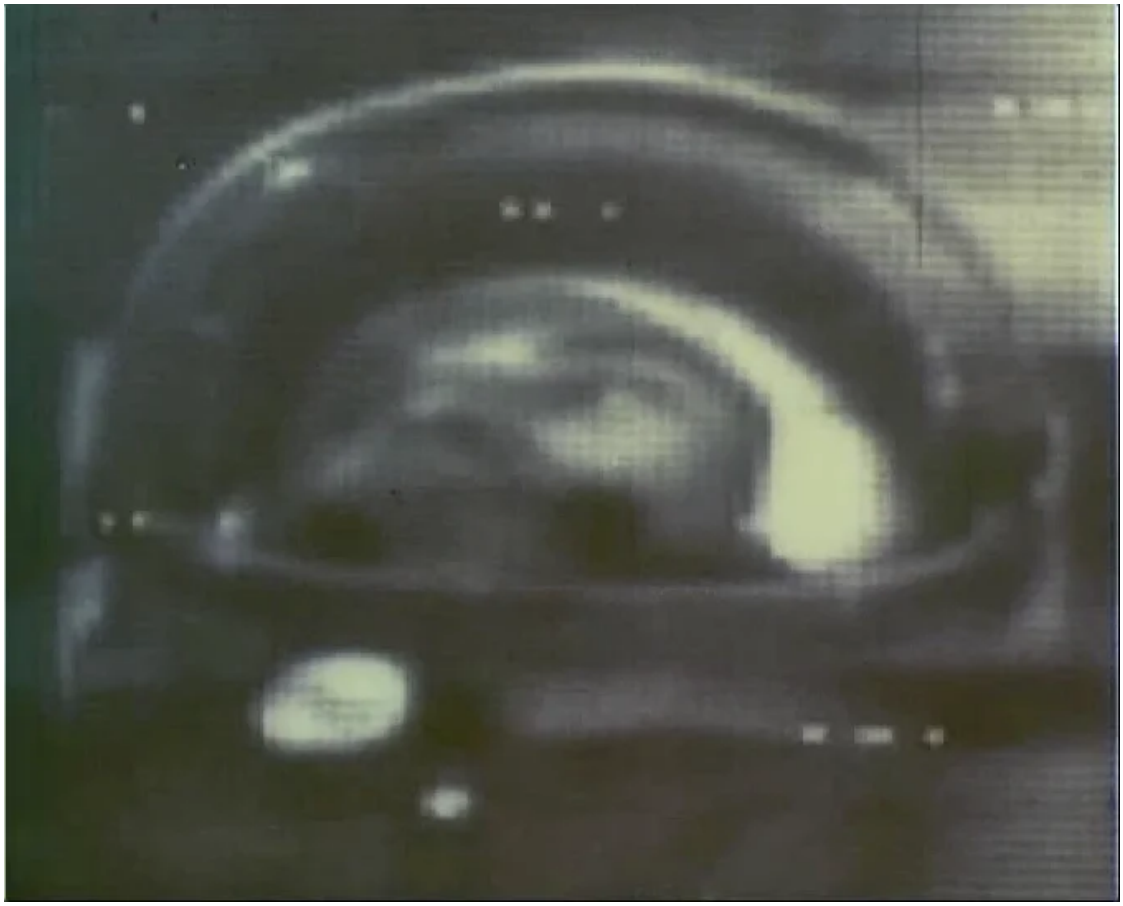
To see on TV in Shabolovka what this signal is showing (remember, G. Grechko said that **at the technical center in Shabolovka, in such a closed room, our television** crews **received a signal from the Moon**), we need to have such the same scan-converter, which turned a non-standard television signal into a television broadcasting standard, into NTSC, as in the USA, or in SECAM, as in the USSR. But this is not the most important thing. This scan converter can be replaced by reshooting a small-frame television monitor (CRT screen) with a standard broadcast television camera.

The main thing is different. There is one link, without which "there will be no kin." In order to view the original TV signal from the Westinghouse camera and get it on the screen of a cathode-ray tube, we must have developed a small-frame television with 320 lines. There should be a kinescope specially designed for this format, and ~~software for it,~~ radio circuits for controlling the movement of the electron beam along the kinescope and forming the necessary frequencies for vertical and horizontal scanning. The Americans apparently had such television, but we did not.

In the history of the development of our space television, there is no such recording format, for 320 lines. The very first cosmovision system "Tral-T" - "Seliger" had 100 lines of expansion. It was a non-standard television system and was intended for service purposes - for television monitoring of the state of astronauts from the moment of their landing on the spacecraft (after a two-hour readiness for launch) and during the entire orbital flight. The Seliger equipment was designed on a Vidicon-type transmitting tube.

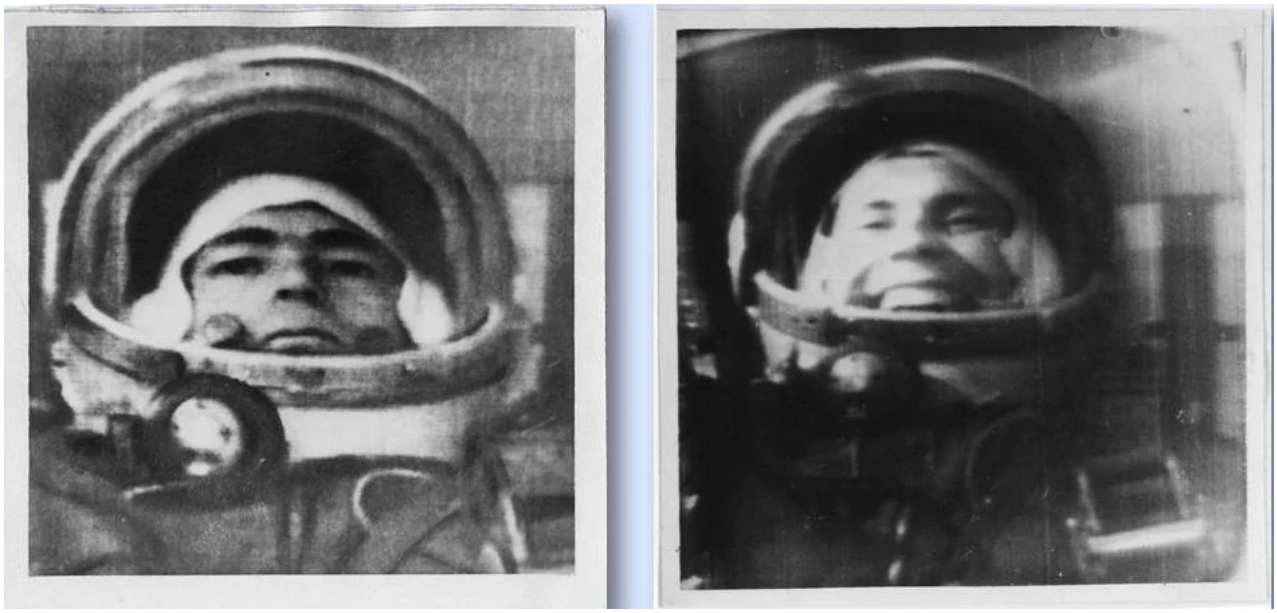
Onboard and ground recording equipment "Seliger" was developed in Leningrad, at the All-Union Scientific Research Institute of Television.

Preserved television footage of the behavior of dogs in the spacecraft in orbit, preserved television images of the first cosmonauts Yuri Gagarin and G. Titov during the flight. TV shooting parameters: 100 vertical lines, frame rate - 10 Hertz, number of brightness gradations - 5. (The image from the monitor was re-captured with a movie camera.)



Yuri Gagarin during a space flight. The image consists of 100 lines.

After the modernization (on the "Hawk" theme), the "Seliger" complex, which included two transmitting cameras on board the spacecraft and sets of receiving (ground) equipment on the NPCs, had to have a resolution of 400 elements per line, with the same number of lines in frame.



Cosmonauts A.G. Nikolaev and P.R.Popovich, 1962. Photographs from a television monitor with a resolution of 400 lines, aspect ratio - 1x1.

And then the task was set to bring the space format closer to the broadcast television of the Soviet Union, that is, 625 lines, 25 "full" frames (50 half-frames).

50 half frames (fields) are associated with the frequency of alternating current in our country - 50 Hz.

Fragment of the cover of the magazine "625" for professional television workers.

And no one in our country was involved in television with 320 lines. Therefore, the talk that we (in the Soviet Union) received a non-standard television signal directly from the moon and watched it on our television is meaningless.

Boris Chertok, a scientist and designer, one of the closest associates of S.P. Korolev, spoke quite unambiguously on this topic. We received television footage of "Armstrong's emergence on the lunar surface" from America via the Eurovision channel.

Boris Chertok.

Here is a quote from his book "Rockets and People. Moon Race".

- Soviet media during the Cold War could not report on our work on the lunar program. Everything was strictly classified. The reports about the outstanding space successes of the Americans were also more than modest, but not for reasons of secrecy. Television reports about the first landing on the moon in human history were broadcast by all countries except the USSR and China. To watch the broadcast from the United States available to the whole world, we had to stop by at NII-88, where the **image was transmitted via cable from the television center. The television center itself received it on the Eurovision channel.** (B. Chertok. Rockets and people. Lunar race.)

Output.

The Soviet Union communicated with Soviet spacecraft in circumlunar orbit and controlled the lunar rovers through a radio telescope in the Crimea and, apparently, understood that the signal from the Apollo was not

coming from the moon. The Soviet Union could not receive the telecast "live from the moon" from "Apollo 11" for three reasons.

1. The moon at the indicated time was on the other side of the Earth - over the Pacific Ocean and over the United States, and was not visible from the Crimea, where the radio telescope was located. The moon rose above the horizon line only 4 hours after the "live broadcast" ended.
2. The American television signal was non-standard, containing 320 lines. This format of television did not exist and was not developed in the Soviet Union.
3. The ground control complex, which included two flight control centers, six ground and three ship control centers located on the territory of the Soviet Union and in certain points of the World Ocean, could not be used to receive information from the Apollo spacecraft, since they worked in a different frequency range with signals having a different structure.

Cameraman L. Konovalov was with you. Until next time!